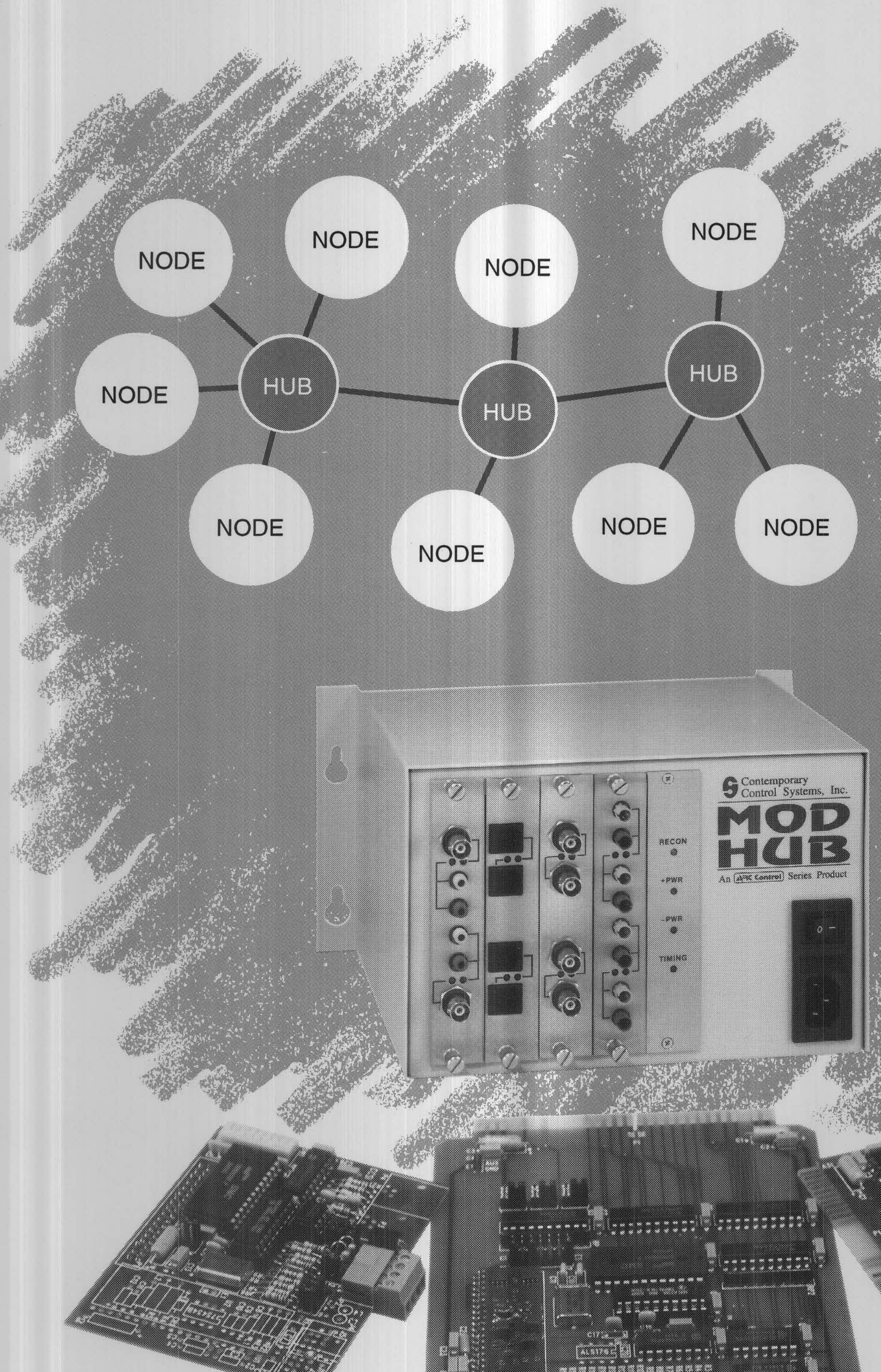
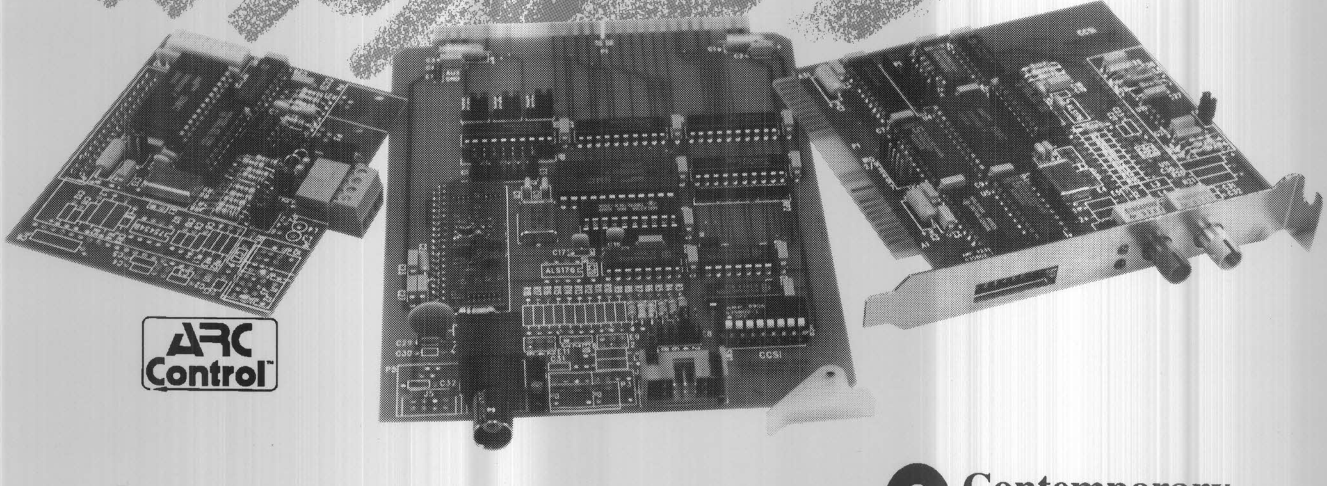


Guide to Configuring an ARCNET® Network with Contemporary Control Systems



ARC Control™

Contemporary Control Systems, Inc.

Contemporary Control Systems, Inc. (CCSI) has been manufacturing ARCNET compatible equipment since 1982. In 1987, we authored a comprehensive book entitled "ARCNET Factory LAN Primer," addressing the use of ARCNET as an effective local area network (LAN) technology for industrial and commercial use. Since then, ARCNET has become an American National Standards Institute (ANSI) standard through the efforts of the ARCNET Trade Association (ATA). This standard, ANSI/ATA 878.1 Local Area Network: Token Bus (2.5 Mbps), describes in detail the intricacies of ARCNET and is available from the ATA office (708/960-5130).

We authored this guidebook as a practical aid for anyone contemplating the installation of an ARCNET LAN. ARCNET is an open standard with equipment available from several vendors. We adhere to the 878.1 specification and common practice among ARCNET vendors. Your comments and questions are always welcomed.

We view ARCNET as an ideal technology for industrial control and process automation and our trademark ARC Control exemplifies our vision—ARCNET for control.

ARC Control™

ARCNET — The Ideal LAN for Control

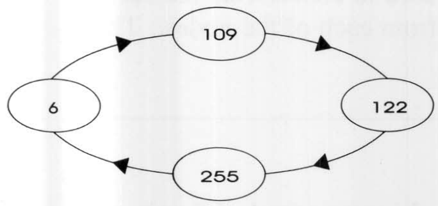
ARCNET is a local area network (LAN) ideally suited for real-time control applications. In terms of the International Organization of Standards OSI (Open Systems Interconnect) Reference Model, ARCNET provides the Physical and Data-link layers. In other words, ARCNET provides for the successful transmission and reception of a data packet between two network nodes. A node refers to an ARCNET controller chip and cable transceiver connected to the network.

Deterministic Performance

The key to ARCNET's performance is its token-passing protocol. In a token-passing network, a node can send a message when it receives the "token." This is the preferred media access control method because all nodes have equal access to the network, eliminating transmission collisions on busy networks. Also, the worst case time for receiving a token can be calculated, an important feature for real-time systems. In other words, ARCNET provides deterministic performance. Finally, the ARCNET protocol "knows" when nodes are added to or deleted from the network and automatically reconfigures the network accordingly without software intervention.

Logical Ring

A token (ITT) is a unique signaling sequence that is passed in an orderly fashion among all the active nodes in the network. When a particular node receives the token, it has the sole right to initiate a transmission sequence or it must pass the token to its logical neighbor. This neighbor, which can be physically located anywhere on the network, has the next highest address to the node with the token. Once the token is passed, the recipient (likewise) has the right to initiate a transmission. This token-passing sequence continues in a logical ring fashion serving all nodes equally. Node addresses range from 0 to 255 with 0 reserved for broadcast messages.



The logical ring has nothing to do with the physical placement of nodes. The node with the next highest address is that node's logical neighbor. However, logical neighbors could be located at the extreme ends of a physical multi-node network.

The highest address is 255 and potentially its logical neighbor is 1. However, in the above example its logical neighbor is 6.

Secure Messages

In a transmission sequence, the node with the token becomes the source node and any other node selected by the source node for communication becomes the destination node. First the source node inquires if the destination node is in a position to accept a transmission (FBE). The destination node responds with either a yes (ACK) or a no (NAK). Upon an ACK, the source node sends out a transmission from either 1 to 507 bytes of data (PAC). If the data was properly received by the destination node as evidenced by a successful CRC test, the destination node sends another ACK. If the transmission was unsuccessful, the destination node does nothing, causing the source node to timeout. The source node will, therefore, infer that the transmission failed and will retry after it receives the token on the next token pass. The transmission sequence terminates and the token is passed to the next node. If the desired message exceeds 507 bytes, the message is sent as a series of packets—one packet every token pass. The packets are recombined at the destination end to form the message.

Automatic Reconfigurations

Another feature of ARCNET is its ability to reconfigure the network automatically if a node is either added or deleted from the network. If a node joins the network, it does not automatically participate in the token-passing sequence. Once it notices that it is never granted the token, it will jam the network with a reconfiguration burst that destroys the token-passing sequence. Once the token is lost, all nodes will cease transmitting and begin a timeout sequence based upon

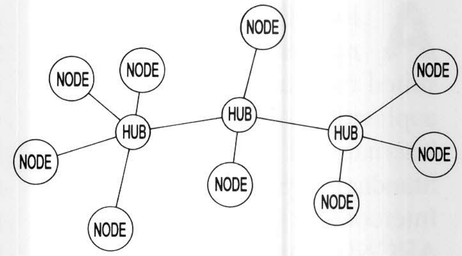
its node address. The node with the highest address will timeout first and begin a token pass sequence to the node with the next highest address. If that node does not respond, it is assumed not to exist. The destination node address is incremented and the token resent. This sequence is repeated until a node responds. At that time, the token is released to the responding node and the address of the responding node is noted as the logical neighbor of the originating node. The sequence is repeated by all nodes until each node learns its logical neighbor. At that time the token passes from neighbor to neighbor without wasting time on absent addresses.

Broadcast Messages

ARCNET supports a broadcast message which is an unacknowledged message to all nodes. Nodes which have been enabled to receive broadcast messages will receive a message that specifies node 0 as the destination address.

Unmatched Cabling Options

ARCNET is the most flexibly cabled network. It supports bus, star and distributed star topologies. In a bus topology, all nodes are connected to the same cable. The star topology requires a device called a hub (passive or active) which is used to concentrate the cables from each of the nodes. The



Distributed Star Topology Using Hubs

distributed star (all nodes connect to an active hub with all hubs cascaded together) offers the greatest flexibility and allows the network to extend up to four miles without the use of extended timeouts. Cabling media support includes coaxial, twisted-pair and glass fiber optics.

ARCNET Transmissions

The ARCNET data-link level protocol is comprised of five basic transmissions. Each transmission is preceded by an alert burst which consists of six consecutive intervals of a logic “1” or mark condition. Each of the transmissions consists of a combination of bytes including ASCII characters, source address (SID), destination address (DID), continuation pointer (CP), data and cyclic redundancy check (CRC). Each byte has appended a preamble consisting of two intervals of mark and one interval of space. Therefore, eleven bits are required to send one byte. The transmissions are as follows:

Invitation to Transmit

ITT =	ALERT	EOT	DID	DID

Free Buffer Enquiry

FBE =	ALERT	ENQ	DID	DID

Data Packets

PAC =	ALERT	SOH	SID	DID	DID	CP	DATA	. . .	DATA	CRC	CRC

Acknowledgement

ACK =	ALERT	ACK

Negative Acknowledgement

NAK =	ALERT	NAK

Network Interface Modules

Each ARCNET node requires an ARCNET controller chip and a cable transceiver which usually reside on a network interface module (NIM). NIMs also contain bus interface logic compatible with the bus structure they support. These network adapters are removable and are, therefore, termed "modules." ARCNET NIMs are available for all the popular commercial bus structures. NIMs differ in terms of the ARCNET controller they incorporate and the cable transceiver supported.

ARCNET Controllers

The heart of any NIM is an ARCNET controller chip which forms the basis of an ARCNET node. Datapoint Corporation developed the original ARCNET node as a discrete electronics implementation, referring to it as a resource interface module or RIM. The first large scale integration (LSI) implementation of the technology was provided by Standard Microsystems Corporation (SMC). Since then other chip manufacturers, such as NCR, developed either replacements or enhanced versions of the original RIM chip.

Use of Hubs

Hubs facilitate cabling by interconnecting multiple NIMs and, in most cases, they exercise no control over the network. The primary function of a hub is to match line impedance. There are two types of hubs which can perform this task—a passive hub or an active hub.

Passive Hubs

Passive hubs are inexpensive, require no power and their sole purpose is to match line impedances which they do with resistors. These hubs usually have four ports to connect four coaxial star transceivers. One of the disadvantages of these hubs is that they limit the network to 200 feet and each segment of the network to 100 feet. Also, unused ports must be terminated with a 93 ohm resistor for proper operation. Passive hubs are used on small (four nodes or less) coaxial star networks.

Active Hubs

Active hubs are essentially electronic repeaters. Although they require power, active hubs support all cabling options, support longer distances than passive hubs, provide isolation and guard against cabling faults and reflections. These are the hubs which are used to cable distributed star networks.

Unused ports on an active hub need not be terminated. Unlike passive hubs, active hubs do not attenuate signals and can be cascaded. A cable failure will affect only one port on an active hub. Active hubs are available as either internal or external devices. Internal hubs reside inside a computer that also have a NIM, while external hubs are stand-alone devices.

ARCNET Controllers

Model	Vendor	Description
90C26	NCR/SMC	First generation ARCNET controller
90C65	SMC	ARCNET controller for XT bus
90C126	NCR	ARCNET controller for XT bus
90C165	SMC	ARCNET controller for XT bus
90C98A	NCR	ARCNET controller with buffer chaining
90C66	SMC	ARCNET controller for AT bus
90C198	NCR	ARCNET controller for AT bus
20010/20020	SMC	ARCNET controller for microprocessors
20051/20051+	SMC	Microcontroller with ARCNET

Multiple Topologies

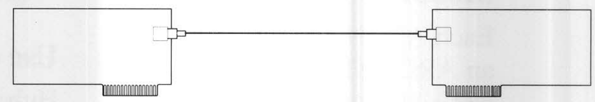
Topology refers to the arrangement of cables, NIMs and hubs within a network. With ARCNET, there are several choices. See the table on page 4. Once the topology is specified, the selection of transceivers can proceed.

Transceiver Options

Various types of transceivers are available depending upon the topology and cable selected. At CCSI we use a suffix appended to the model number of the product to identify which transceiver exists with that product. This practice is utilized on both CCSI's active hub and network interface module (NIM) product lines. The chart on page 5 lists the available transceivers that are required for a particular cable and topology.

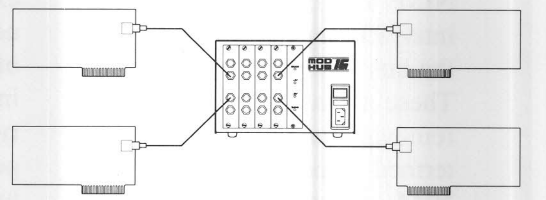
Point-To-Point

In the point-to-point connection, only two NIMs are used. This is the simplest of networks. Each -CXS NIM effectively terminates the other NIM; therefore, no hub is required.



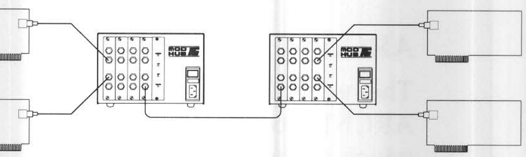
Star

The star connection requires hubs. Each -CXS NIM connects to one point on the hub which effectively terminates the connected NIM. Since only one NIM is connected to any one hub port, faults in a cable or at a node can be easily isolated. Cabling a facility is often easier with a star topology.



Distributed Star

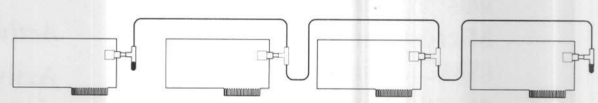
If several active hubs are used, a distributed star topology can be implemented. This topology is the most flexible cabling method available in ARCNET LANs since both node-to-hub and hub-to-hub connections are supported. Two or more active hubs, each supporting a cluster of connected nodes, are linked together by a “home run” cable.



The distributed star topology helps reduce cabling costs since each node connects to a local hub, thereby eliminating the need to run each node’s cable over to one wiring location. Like the star configuration, nodes are isolated from one another.

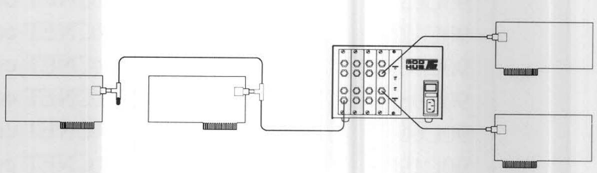
Bus

In the bus configuration, NIMs equipped with high impedance transceivers (-CXB), (-TPB) or RS-485 drivers (-485, -485X) must be used. Using RG-62/u coaxial cable and BNC “Tees,” or twisted-pair cable, several NIMs can be connected without the use of a hub. Termination is provided by the installation of a resistive terminator at both ends of the cable segment. The advantage of this configuration is that no hub is required. The disadvantage is that one node failure could disrupt the complete network. Also, cabling distances are less than the star or point-to-point connection.



Star/Bus

To bridge a bus topology to a star requires an active hub. In this case, the active hub acts as both a terminator for the bus and a repeater for the network. Remove the passive terminator from one end of the bus and connect that end to one port on the active hub. Other ports on the active hub can now be used for other bus or star connections.



Transceivers Must Match the Cable and Topology

-CXS Coaxial Star
Typically, ARCNET is cabled with RG-62/u coaxial cable (with BNC connectors) in a star topology, each NIM connects directly to a port on an active or passive hub. Alternatively, RG-59/u coaxial cable can be used, but at a cost of reduced distances between a node and a hub. Overall, coaxial cable offers good performance, good noise immunity, low propagation delays, low signal attenuation, sufficient ruggedness and low cost. The coaxial star configuration also provides the longest coaxial distance and simplified troubleshooting.

-CXB Coaxial Bus
RG-62/u coaxial cable can be used in a bus configuration using BNC "Tee" connectors with passive terminators at each end of the cable. Although hubs are not required, cabling options are restricted and troubleshooting is much more difficult. There is a minimum distance between adjacent nodes. Coaxial bus is used when reliable coaxial cable communication is required in a hubless system when shorter distances are involved.

-TPS Twisted-Pair Star
Unshielded twisted-pair wiring such as IBM Type 3 (#24 or #22 AWG solid copper twisted-pair cable or telephone wiring) can be used. BALUNs are required at both the hub and NIM to use this cable. CCSI's twisted-pair NIMs and hubs have internal BALUNs, so external BALUNs are not needed. Twisted-pair is convenient to install; however, its attenuation exceeds coaxial, its noise immunity is less, and its maximum length between a node and a hub is lower. RJ-11 connectors are used with this cable.

-TPB Twisted-Pair Bus
The convenience of twisted-pair wiring can be used in a bus configuration without the use of BALUNs. Dual RJ-11 jacks are provided so that modules can be wired in a "daisy-chain" fashion even though electrically they are connected as a bus. Distances are limited as well as node count. Passive terminators are inserted in unused jacks at the far end of the segment. For small hubless systems this approach is attractive.

-FOG Glass Fiber Optics
Duplex glass, multimode fiber optic cable uses either SMA or ST™ connectors and is available in three sizes: 50/125, 62.5/125 and 100/140. Larger core sizes launch more energy allowing longer distances. The industry appears to have selected 62.5/125 as the preferred size. This core size provides long distances, immunity to electrical noise, lightning protection and data security. Glass fiber optic cable is used in hazardous areas and interbuilding cabling on campus installations or whenever metallic connections are undesirable. Connectors can be either SMAs or STs. The STs look like a small BNC and are more tolerant to abuse than SMA. ST connectors have become more popular than the traditional SMA connector.

-485 DC Coupled RS-485
One popular cabling standard in industrial installations is RS-485. A single twisted-pair supports several nodes over a limited distance. Four screw connections or twin RJ-11 jacks are provided so that the modules can be wired in a "daisy-chain" fashion. RS-485 offers a hubless solution, but with limited distance and low common mode breakdown voltage.

-485X AC Coupled RS-485
The RS-485 transformer coupled option provides the convenience of RS-485 connectivity, but with a much higher common mode breakdown voltage. Distances and node count are reduced from the DC coupled RS-485 (-485) option. The AC coupled option is insensitive to phase reversal of the single twisted pair which connects the various nodes.

Several Choices of Cable

Once the topology and transceiver are specified, the cable can be selected. There are basically three choices in cabling: coaxial, twisted-pair and fiber optic. Each type has its advantages and when using active hubs all three types of cabling can be mixed within one network—an example of ARCNET's extreme flexibility.

Coaxial Cable

RG-62u was the original choice for cabling ARCNET systems, and we recommend its use over RG-59/u if possible. RG-62/u (93 ohm) is a better impedance match to the coaxial transceiver and has less attenuation than RG-59/u (75 ohm) yielding greater distances. Standard BNC connectors and tees are used. Coaxial cable is relatively inexpensive and provides the highest propagation factor compared to other alternatives.

Twisted-Pair

Unshielded twisted-pair cabling can be used with several transceivers including those for RS-485. We recommend IBM type 3 for vendors (although other unshielded twisted-pair cable with similar characteristics will also work). Twisted-pair cable is inexpensive and convenient to use and easy to terminate. However, twisted-pair cable has much greater attenuation than coaxial cable and, therefore, has limited distance capability.

Fiber Optics

Fiber offers the greatest distance but requires more attention to its application. There are many varieties of cables and cable pairs. We recommend the use of 62.5/125 duplex cable for each link. For indoor applications, we recommend tight buffering and for outdoor loose buffering. Also study the attenuation figures for the specified fiber to ensure that it is within the available power budget. Fiber optics can span the greatest distance, but has a lower propagation factor than coaxial cable. It may be necessary to calculate the resulting signal delay to ensure it is within ARCNET limits.

Electrical Code

Cable installations must comply with both federal and local ordinances. Plenum-rated (within air distribution systems) and riser-rated (between floors) cables are available, but at a higher cost, to meet the requirements of the National Electric Code (NEC). Consult the relevant documents for applicability to your installation.

Recommended Cables

There are many vendors of quality cabling. In the table below, we have listed a manufacturer and associated part number for each of the main types of cabling media used in an ARCNET LAN. We have found each of these recommended cables to be highly reliable. Please note that these are recommendations and should not be considered as the only options for cabling your ARCNET LAN. Fiber optic cable selection will require application attention since different cables exist for indoor and outdoor use.

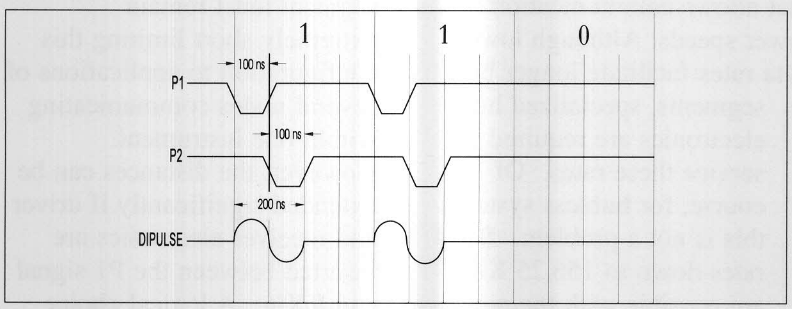
Recommended Cables

Cable	Type	Non-Plenum	Plenum	Attenuation	Propagation Factor
RG-62/u	Coaxial	Belden 9269	Belden 89269	5.5 dB/1000 ft	85%
#24 AWG twisted	IBM Type 3	Belden 1154A	Belden 1155A	17.9 dB/1000 ft	60%
50/125	Glass fiber optics		Belden 227812	3.5 dB/km	67%
62.5/125	Glass fiber optics		Belden 225812	3.5 dB/km	67%

The original ARCNET specification called for RG-62/u coaxial cable as the media between hubs and NIMs. With the desire to eliminate hubs, the bus transceiver was developed but RG-62/u coaxial cable remained as the specified cable. Therefore, there are two transceivers: coaxial star (-CXS) for distributed star systems and coaxial bus (-CXB) for hubless systems.

P1, P2 Signaling

All ARCNET controller chips develop two signals called P1 and P2 that drive the coaxial transceiver (sometimes referred to as the hybrid). Both P1 and



P2 are negative true signals of 100 nanoseconds in duration with P2 immediately following P1. These signals occur when an ARCNET controller transmits a logic “1.” If a logic “0” is to be transmitted, no pulses are sent and the line remains idle. The sum of P1 and P2 is 200 nanoseconds; however, one signaling interval of ARCNET requires 400 nanoseconds. The remaining 200 nanoseconds are absent of signaling. A center-tapped transformer is wired to two drivers connected to P1 and P2. When P1 is received by the transceiver, the coaxial cable is driven in a positive direction for the duration of the pulse. When P2 is received by the transceiver, the coaxial cable is driven in a negative direction for the duration of the pulse. The resulting signal is called a dipulse which approximates a single sine wave. Since this all occurs over a 200 nanosecond interval, the waveshape appears as a 5 Mhz signal instead of 2.5 Mhz which is what we would expect with ARCNET. Therefore, cable attenuation calculations should be made at 5 Mhz instead of 2.5 Mhz. Since the dipulse has no DC component, transformer operation is simplified.

-CXS vs. -CXB

The coaxial star transceiver and the coaxial bus transceiver both receive P1 and P2 signals and generate dipulse signals. However, the -CXS transceiver represents a low impedance (approximately 93 ohms) when operating while the -CXB transceiver represents a high impedance when idle allowing for multiple transceivers to be attached to a common bus. Since the two transceivers appear the same, it is important to distinguish one from another. We recommend the following practice. For -CXS transceivers, use black bodied BNC connectors on the printed-circuit board. For -CXB transceivers, use white.

The capabilities of the two transceivers differ significantly. The -CXS transceiver can drive 2000 feet of RG-62/u cable while the -CXB can only drive 1000 feet. However, the -CXB transceiver can support eight nodes on a single segment. Connections between nodes are made with BNC Tee connectors and coaxial cables of at least six feet in length. Passive termination is required at the ends of bus segments. The isolation of the two transceivers is 1000 volts DC.

Twisted-Pair Star

Twisted pair is also a popular cabling technology. It is inexpensive and easy to terminate. However, it has much higher attenuation than coaxial cable limiting its use to shorter distances. Frequently, modular jacks and plugs are used to interconnect segments. Twisted-pair cable can be used with conventional coaxial star transceivers if a BALUN is used between the cable and the transceiver. We recommend the MUX LAB 10070 for use as an external BALUN. It has a male BNC connector at one end and a RJ-11 jack at the other, and it must be used only with coaxial star (-CXS) transceivers. For convenience, CCSI has provided a product that eliminates the need for external BALUNs. The twisted-pair star (-TPS) option provides an internal BALUN along with a -CXS transceiver. Simply connect to the provided RJ-11 jack. When using

BALUNs, only star and distributed star topologies are supported. No phase reversal of the wiring is allowed. Many modular plug patch cables invert the wiring. To test for this, hold both ends of the cable side by side with the retaining clips facing the same direction. The color of the wire in the right-most position of each plug must be the same if there is no inversion of the cable. If this is not the case, the cable is inverted.

Twisted-Pair Bus

For hubless systems, twisted pair bus (-TPB) transceivers can be used. Since modular jacks are used and a bus connection is required, two jacks, internally wired together, are provided on each NIM.

Modular Connector Pin Assignments

4-Contacts Pin	Usage	6-Contacts Pin	Usage	8-Contacts Pin	Usage
1		1		1	
2	LINE-	2		2	
3	LINE+	3	LINE-	3	
4		4	LINE+	4	LINE-
		5		5	LINE+
		6		6	
				7	
				8	

Field connections are then made in a daisy chain fashion to each successive NIM. The remaining end jacks are then plugged with passive terminators. A modular plug terminator is available for this use. Each daisy chain cable must not invert the signals and must be at least six feet long for reliable operation.

Hubs can be used to extend twisted-pair bus segments. Use a twisted-pair star (-TPS) hub port in place of the passive terminator at one end of the segment. Connect this last port on the NIM to the -TPS port on the hub using an "inverted" modular plug cable. This is necesary since the BALUN in the -TPS port creates a signal inversion which is not compatible with the -TPB port. The interconnecting inverted cable "rights" the signal. Connect the second twisted-pair bus segment in a similar fashion using an additional -TPS port.

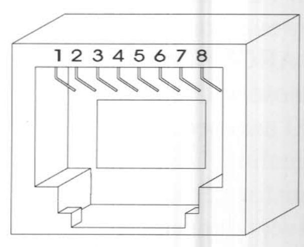
Baud Rate Selection

Conventional ARCNET NIMs communicate only at a 2.5 Mbps rate. Newer generation 20020/20051 ARCNET controllers have a prescaler that allows communication at lower speeds. Although lower data rates facilitate longer bus segments, specialized hub electronics are required to service these rates. Of course, for hubless systems this is not a problem. Baud rates down to 156.25 Kbps are possible with the new generation controllers. Do not change baud rates on systems with dipulse transceivers since the transceiver is tuned to 2.5 Mbps.

Backplane Mode

The 20020/20051 ARCNET controller family offers two additional interfaces not available in earlier generation controllers. Upon power up, the 20020/20051 chip defaults to conventional ARCNET mode where P1 and P2 signals are generated to develop the required dipulse signal. However, if backplane mode is programmed into the 20020/20051, the P1 signal is stretched into a 200 nanosecond signal and P2 becomes a clock. The sense of the receiver pin (RXin) is inverted so that it may be tied directly to the negative true P1. In the simplest configuration, the P1 and RXin pins of all the controllers that are to communicate to one another are tied together using a single pullup resistor. The bus segment must remain extremely short limiting this configuration to applications of several nodes communicating within one instrument. However, the distances can be extended significantly if driver and receiver electronics are inserted between the P1 signal and RXin. A logical choice would be RS-485 due to the popularity of the standard. To implement a party line RS-485 requires one additional signal called TXEN which is generated by the 20020/20051. This signal is ignored in conventional dipulse mode and unavailable on earlier ARCNET controllers.

Prescaler (divide by)	Date Rate (Kbps)
8	2500
16	1250
32	625
64	312.5
128	156.25



RJ-45 Modular Jack

Introduction to RS-485

EIA's RS-485 standard supports multimaster operation and is, therefore, suitable for use with ARCNET in either backplane or non-backplane modes. Non-backplane mode implementations require an extended P1 signal and the generation of TXEN. Two RS-485 implementations are supported on ARCNET, DC-coupled (-485) and AC-coupled (-485X). The capabilities of each approach are different.

DC Coupled 485 (-485)

The original RS-485 specification deals with the problem of data transmission over a balanced transmission line in a party-line configuration. With ARCNET, any node can transmit; therefore, multiple drivers and receivers share a common twisted-pair cable. RS-485 does not specify a communications protocol and, therefore, a means must be provided that ensures only one driver has access to the media at any one time. ARCNET provides its own media access control (MAC), and it is used to successfully implement the RS-485 network.

Standard Microsystems Corporation (SMC) has made recommendations on how to implement RS-485 with ARCNET. They studied reflections, signal attenuation and DC loading. Since RS-485 does not specify a modulation method or maximum data rate, rules need to be developed for ARCNET based RS-485 networks.

In order to reduce reflections, it is necessary to terminate the cable in its characteristic impedance. Since the driver can be located anywhere along the network, a terminator must be supplied at both ends of the cable. It is recommended that unshielded twisted-pair cable with a characteristic impedance of 100 to 120 ohms be used. Therefore, matching terminators must reside at each end of the segment.

Only one driver is enabled at any one time in an operating network; however, there are times when no drivers are operational causing the twisted-pair cable to float. Noise and reflections along the line can cause the various receivers to incorrectly detect data creating data errors. These receivers need to be biased into their "off" state to ensure reliable operation. Decreasing the bias resistance reduces the reflections but can load the drivers excessively. Also, the amount of bias required increases with the number of receivers on the line. Since differential receivers are used, both pullup and pulldown resistors are required to properly bias the receivers. Through experimentation, SMC recommends an optimal biasing resistor of 810 ohms. We recommend that this resistance be distributed over two modules—each located at the ends of a segment in order to simplify the cabling rules. The modules at the ends of the segment will be strapped for biasing resistors and a line terminator while all other modules will have no biasing or termination. Since two modules are being used to supply bias, their resistors will be increased to 1600 ohms. With this approach, a total of 17 nodes can share a single segment up to 900 feet in length.

Although differential line drivers and receivers are used, this fact does not remove the need for a common ground among all the nodes. A cold water pipe connection is a possibility. The common mode voltage experienced by any one node should not exceed +/- 7 volts. A good grounding system would ensure that this requirement is met.

AC Coupled RS-485 (-485X)

One method to achieve a much higher common mode rating is to transformer couple the RS-485 connection. SMC has developed such an approach achieving a common mode rating of 1000 volts DC. This implementation does not require biasing resistors as does the DC coupled approach; however, line terminators must still be applied at each end of the cable segment. The AC coupled RS-485 approach has the additional advantage that connections to each node are insensitive to phase reversal. Polarity of the wiring need not be observed. However, the -485X implementation is rated at 13 nodes maximum over 700 feet of cable.

Extending bus segments beyond the 700 or 900 foot limit is possible with the introduction of active hubs.

Introduction

The use of fiber optics in LANs, such as ARCNET, has increased due to the inherent advantages of using fiber. High data rates can be maintained without electromagnetic or radio frequency interference (EMI/RFI). Longer distances can be achieved over that of copper wiring. For the industrial/commercial user, fiber offers high-voltage isolation, intrinsic safety and elimination of ground loops in geographically large installations. ARCNET will function with no difficulty over fiber optics as long as some simple rules are followed.

There are varying types of fiber optic cabling, but basically we recommend the use of the larger size fiber in diameters of 50, 62.5 and 100 microns. With this size fiber, multimode operation will be experienced requiring the use of graded index fiber.

We require the use of duplex cable since each fiber optic port consists of a separate receiver and transmitter which must be cross connected to the separate receiver and transmitter at the distant end. Only star and distributed star topologies are supported.

CCSI's technology operates over the 850 nm range.

Optical Power Budget

When specifying a fiber optic installation, attention must be paid to the available optical power budget. The power budget is the ratio of the light source strength divided by the light receiver sensitivity expressed in dB. This value must be compared to the link loss budget which is based upon the optical cable and optical connectors. The link loss budget must be less than the power budget. The difference is called the power margin which provides an indication of system robustness.

Transmitter power is typically measured at one meter of cable and, therefore, includes the loss due to at least one connector. The outputs vary so CCSI tests each device to ensure that a minimum output power is achieved. The output power also varies with core sizes. In general, larger cores launch more energy.

Receiver sensitivity also varies so again CCSI tests for the least sensitive receiver. The difference between the weakest transmitter and least sensitive receiver is the worst case power budget which CCSI specifies. Realized power budgets will exceed this value since the probability of the worst case transmitter being matched with the worst case receiver is remote. However, CCSI recommends using the stated power budgets for each core size.

Optical Power Budget (25°C)

Fiber Size (Microns)	Transmit PWR (dBm)	Receiver PWR (dBm)	Power Budget (dB)
100/140	-9.5	-25.4	15.9
62.5/125	-15	-25.4	10.4
50/125	-18.8	-25.4	6.6

Link Loss Budget

Fiber optic cable attenuation is usually specified by the cable manufacturer. Use this figure to determine the maximum distance of the fiber link. It is necessary to include losses due to cable terminations. Connectors usually create a loss of from 0.5 to 1 dB. For example, assume a 1500 meter run of 62.5 cable which the cable manufacturer specifies as having a cable attenuation of 3.5 dB per 1000 meters. The cable loss will be 5.25 dB. Assuming two connector losses of 0.5 dB each, the link loss budget would be 6.25 dB which is within the 10.4 dB power budget specified by CCSI. The 5.15 dB difference represents a high degree of margin. A 3 dB margin is what is typically recommended.

Overdrive

Overdrive occurs when too little fiber optic cable is used resulting in insufficient attenuation. To correct this condition, a jumper can be inserted in each fiber optic transceiver to reduce the gain sufficiently to allow for a zero length of fiber optic cable to be installed between a transmitter and receiver. This is potentially a problem with 100 micron cable. By removing the jumper, a 2 dBm reduction in output power is achieved.

Permissible Segment Lengths

A segment is defined as any portion of the complete ARCNET cabling system isolated by one or more hub ports. On a hubless or bus system, the complete ARCNET cabling system consists of only one segment with several nodes, however, a system with hubs has potentially many segments. An ARCNET node is defined as a device with an active ARCNET controller chip requiring an ARCNET device address. Active and passive hubs do not utilize ARCNET addresses and, therefore, are not nodes. Each segment generally supports one or more nodes but in the case of hub-to-hub connections, there is the possibility that no node exists on that segment.

The permissible cable length of a segment depends upon the transceiver used and the type of cable installed. The following table provides guidance on determining the constraints on cabling distances as well as the number of nodes allowed per bus segment.

The maximum segment distances were based upon nominal cable attenuation figures and worst case transceiver power budgets. Assumptions were noted.

When approaching the maximum limits, a link loss budget calculation is recommended.

When calculating the maximum number of nodes on a bus segment, do not count the hub ports that terminate the bus segment as nodes. However, do consider the maximum length of the bus segment to include the cable attached to the hub ports.

Several bus transceivers require a minimum distance between nodes. Adhere to this minimum since unreliable operation can occur.

Permissible Cable Lengths and Nodes Per Segment

Trans-ceiver	Description	Cable	Connectors	Cable Length Min	Cable Length Max	Max Nodes Bus Segment	Notes
-CXS	coaxial star	RG-62u	BNC	0	2000ft/610m	N/A	5.5 dB/1000ft max
-CXS	coaxial star	RG-59/u	BNC	0	1500ft/457m	N/A	7.0 dB/1000ft max
-CXB	coaxial bus	RG-62/u	BNC	6ft/2m[1]	1000ft/305m	8	5.5 dB/1000ft max
-TPS	twisted-pair star	IBM type 3	RJ-11	0	330ft/100m	N/A	uses internal BALUNs
-TPB	twisted-pair bus	IBM type 3	RJ-11	6ft/2m[1]	400ft/121m	8	
-FOG	duplex fiber optic	50/125	SMA or ST	0	3000ft/915M	N/A	4.3 dB/km max
-FOG	duplex fiber optic	62.5/125	SMA or ST	0	6000ft/1825m	N/A	4.3 dB/km max
-FOG	duplex fiber optic	100/140	SMA or ST	0[2]	9000ft/2740m	N/A	4.0 dB/km max
-485	RS-485 DC	IBM type 3	screw or RJ-11	0	900ft/274m	17	DC coupled
-485X	RS-485 AC	isolated IBM type 3	screw or RJ-11	0	700ft/213m	13	transformer isolated

1 This represents the minimum distance between any two nodes or between a node and a hub.
2 This minimum can only be achieved by removing a jumper on the transceiver circuitry.

Extended Timeouts

Originally ARCNET was specified to have a four mile maximum distance limitation which could be achieved with eleven segments of RG-62/u coaxial cable and ten active hubs. The resulting 22,000 feet (slightly more than four miles) represented the worst-case distance between two extreme nodes. Actually, the distance constraint has more to do with time delay. With standard timeouts, the round trip propagation delay between any two nodes plus the turnaround time (the time for a particular ARCNET node to start sending a message in response to a received message which is 12.7 µs) shall not exceed the response time limit of 74.7 µs. This means that the one-way propagation delay shall not exceed 31 µs which is approximately what 22,000 feet of coaxial cable and ten hubs represent. For the vast majority of systems, this is not an issue; however, when considering fiber optic or broadband systems a delay budget calculation should be performed to determine if extended timeouts are required.

ET2	ET1	Response Time (µs)	Idle Time (µs)	Reconfig Time (ms)
0	0	1209.6	1318.4	1680
0	1	604.8	659.2	1680
1	0	302.4	329.6	1680
1	1	75.6	82.4	840

There are four possible timeouts that can be selected using register bits ET1 and ET2 in the ARCNET controller chip. It must be remembered that all ARCNET nodes in the network must be set for the same timeout settings. Upon powerup, all ARCNET controllers assume the standard timeout of 75.6 µs (ET1=ET2=1). Besides the response time, extended timeouts affect the idle time (the time a node waits before incrementing the next ID counter during a reconfiguration) and the reconfiguration time (the time a node waits before initiating a reconfiguration burst). The accompanying table shows the relationship.

Component	Delay (ms)
Passive Hub	0.01/hub
Active Hub	0.25/hub
RG-62/u cable	0.12/100 feet
RG-59/u cable	0.12/100 feet
IBM Type 3 cable	0.17/100 feet
50/125 fiber cable	0.15/100 feet
62.5/125 fiber cable	0.15/100 feet
100/140 fiber cable	0.15/100 feet

Delay Budget

Every attempt should be made to ensure that the ARCNET system will function with the standard or default timeouts. This would simplify the installation and maintenance of the network since all ARCNET controllers default to the lesser timeout setting upon powerup without any software intervention.

Use the accompanying chart to sum all the delays encountered between the two geographically furthest nodes. Include the delays resulting from both hubs and cables. Notice that the propagation delay for coaxial cable is less than for fiber optic cabling. If the total amount of one-way direction delay for the worst case situation exceeds 31 µs, then the timeouts must be extended.

Termination

A benefit of using active hubs is that no passive-termination is required at each port nor must unused ports be terminated. Only bus segments of either coaxial or twisted-pair cabling require termination. Termination for twisted-pair cable includes RS-485. In general, passive termination equal to the characteristic impedance of the cable needs to be applied at each end of the bus segment. If one end of the bus segment attaches to a port on an active hub, no termination is required at that end.

For RG-62/u cable, use a 93 ohm terminator attached to a BNC Tee connector. For twisted-pair cable, use a matching terminator that plugs into the unused RJ-11 connector at each end of the bus segment. If no RJ-11 connector exists, use a discrete resistor attached to screw terminals or with some NIMs—an onboard terminator can be invoked by inserting a jumper.

Model	Description
BNC-T	BNC "Tee" connector
BNC-TER	BNC 93 ohm terminator
TPB-TER	RJ-11 100 ohm terminator

OSI Model

The Open Systems Interconnection (OSI) model describes the various layers of services that may be required in ordered for two or more nodes to communicate to one another. ARCNET was developed before the model was adopted and, therefore, does not fit the strict definitions of the various layers. ARCNET does conform to the physical layer and to the media access control (MAC) portion of the data-link layer as defined by IEEE. The network layer is not supported directly, but portions of the transport layer are supported such as flow control and guaranteed packet delivery. With additional software, as much of the model as desired can be implemented.

Much software is available that supports ARCNET communications. Since this software links to a particular ARCNET controller chip on a particular NIM, care must be exercised that commercially available software will operate on your system. Here are some of the possibilities:

Proprietary—OEM products with resident manufacturer developed software

Control Link—SMC developed IEEE 802.2 services

NetBIOS—ATA endorsed session level software adhering to IBM and Microsoft standards. Used with several peer-to-peer network operating systems.

NDIS—Network Driver Interface Specification developed by Microsoft. Used with Windows for Workgroups.

ODI—Open Data-link Interface developed by Novell and supported by Microsoft. Used with Novell's NetWare.

IPX/SPX—Internetworking standard developed by Novell and supported by Microsoft. Used with Novell's NetWare.

ATA—ARCNET Trade Association

The ATA has a standards committee which has developed or is developing ARCNET related standards. Besides endorsing an ARCNET NetBIOS, the ATA is involved with three standards:

ANSI/ATA 878.1 Local Area Network: Token Bus (2.5 Mbps)
This approved standard defines the basic ARCNET technology, as well as recommending certain practices that increase reliability and interoperability.

ATA 878.2 ARCNET Packet Fragmentation Standard
This proposed standard addresses the problem of handling data packets which exceed the maximum number of characters that can be sent in one ARCNET transmission. The data packet is fragmented into manageable ARCNET frames which are recombined at the destination node.

ATA 878.3 Encapsulation Protocol Standard
This proposed standard defines a method in which industry standard master/slave protocols can be encapsulated into ARCNET allowing for multimaster operation.

ARCNET Trade Association

Contemporary Control Systems, Inc. was instrumental in creating the ATA in 1987. The ATA was formed for the dual purpose of developing working standards for ARCNET and promoting the use of ARCNET as a viable networking technology. The ATA is recognized by the American National Standards Institute (ANSI) as a standards development body and was instrumental in achieving ANSI recognition of the ARCNET standard with ANSI 878.1 Local Area Network: Token Bus (2.5 Mbps). The ATA has been working on other standards that would ease the implementation of ARCNET in various industries. The ATA remains as a worldwide clearing house for information regarding ARCNET technology.

To learn more about the ATA and its activitites, call the association office at 708/960-5130 (fax 708/963-2122).

APPLICATION	
PRESENTATION	
SESSION	
TRANSPORT	
NETWORK	
DATA-LINK	Logical Link Control Media Access Control
PHYSICAL	

OSI Reference Model

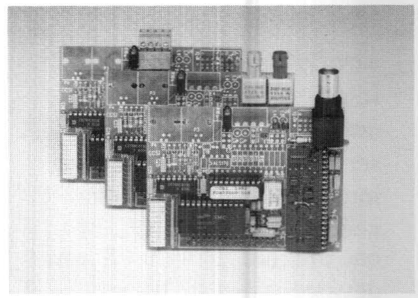
Network Interface Modules

CCSI manufactures network interface modules for all the popular computer bus structures. On some bus structures, more than one type of ARCNET controller chip is available. Earlier generation ARCNET controllers require an I/O address, memory address and interrupt line. Later generation controllers require only a memory address and interrupt line. Where applicable, 16-bit interfaces are provided.

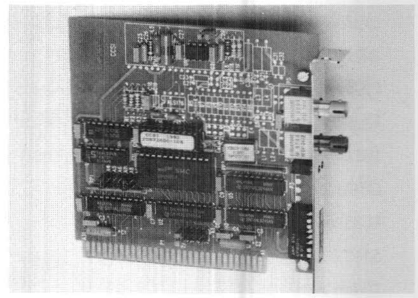
Each NIM model is available in several transceiver options and must be specified at the time of order. A suffix is appended to the base model number to identify the transceiver.

Several of the bus structures such as ISA, PC/104 and STD support personal computer standards for which there is much standardized software for ARCNET. CCSI's PC compatible NIMs will operate with this software. For embedded systems, we recommend the SBX series of modules which support Intel's Multimodule specification. If an SBX header is available on the embedded system, the SBX module can provide a convenient network connection.

CCSI has driver software to facilitate those customers who are developing proprietary networking software. Contact the factory for details.



The SBX20 series supports coaxial, fiber optic and twisted-pair cabling including RS-485.



The PCX20 series ARCNET adapter is designed for ISA bus compatibility.

Computer Bus Structures

ISA	–	Personal Computer Industry Standard Architecture (IEEE P996)
PC/104	–	Embedded Personal Computer Module (IEEE P996 variant)
SBX	–	Intel's Multimodule Specification 142686-002
STD	–	Simple to Design (IEEE 961)

Network Interface Module Selection Guide

Model	Computer Bus	Bits 8/16	ARCNET Controller	Transceiver Options -CXS	-CXB	-TPS	-TPB	-FOG	-485	-485X
PCA	ISA	16	90198	●	●					
PCX	ISA	8	9065	●	●	●		●		
PCX20	ISA	8	20020	●	●		●	●	●	●
PC10420	PC/104	8	20020	●	●		●	●	●	●
SBX20	SBX	8	20020	●	●		●	●	●	●
STD20	STD	8	20020	●	●		●	●	●	●

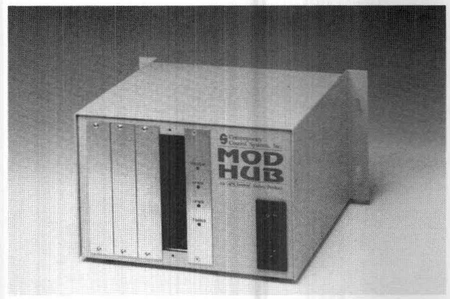
MOD HUB — Modular Active Hub

The MOD HUB series of modular ARCNET active hubs provides the ultimate in reliability and flexibility in cabling an ARCNET system. Using field installable expansion modules (EXP), any mix of coaxial, fiber optic or twisted-pair cabling can be supported to the extremes of the ARCNET specification.

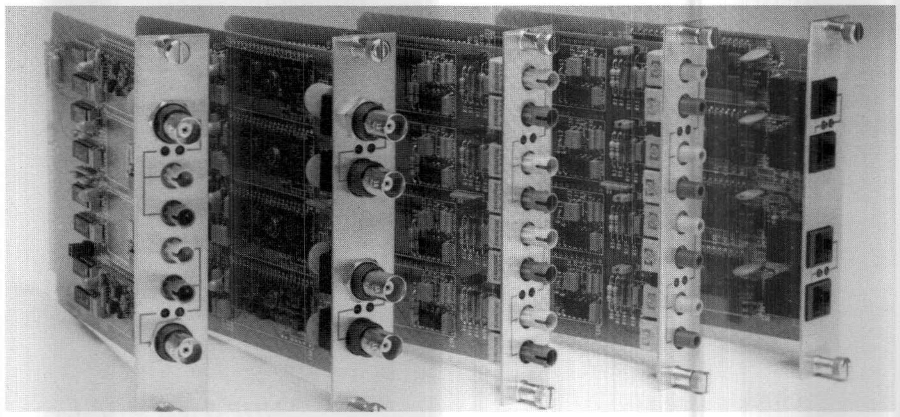
The MOD HUB is available in either 4 slot (16 port) or 12 slot (48 port) configurations. Expansion modules are purchased separately. The MOD HUB powered enclosure features a universal power supply for international use. Currently, agency registrations include UL and C/UL. There are several LED indicators on the MOD HUB including two which monitor the power supplies and one for indicating that a reconfiguration has occurred on the connected ARCNET LAN. The MOD HUB is available in table-top, panel-mount and rack-mount configurations addressing all the common mounting practices.

Expansion modules carry an EXP prefix followed by a suffix that indicates the transceiver that is supported. Some modules support two different types of transceivers on the same module and, therefore, have a second suffix. All expansion modules have four ports and occupy one slot in the MOD HUB enclosure.

The MOD HUB series has been specified by several original equipment manufacturers (OEMs) as the equipment of primary choice when providing connections to an ARCNET LAN.



MOD HUB-16F
4-slot enclosure supports up to four expansion modules.



EXP expansion modules support coaxial, fiber optic and twisted-pair cabling.

MOD HUB Enclosures

MODHUB-16	16-Port Powered Enclosure
MODHUB-16E	16-Port Powered Enclosure (240V)
MODHUB-16F	16-Port Flange-Mounted Enclosure
MODHUB-16EF	16-Port Flange-Mounted Enclosure (240V)
MODHUB-16F-N	16-Port NEMA 1 Enclosure
MODHUB-48	48-Port Powered Enclosure
MTG-RAK	19" Rack-Mounting Kit

MOD HUB Expansion Modules

EXP-CXS	4-Port Coaxial Star Expansion Module
EXP-CXS/FOG[1]	2-Port Coax/Fiber Expansion Module
EXP-CXS/485[2]	2-Port Coax/RS-485 Expansion Module
EXP-FOG[1]	4-Port Fiber Expansion Module
EXP-485[2]	4-Port RS-485 Expansion Module
EXP-485[2]/FOG[1]	2-Port RS-485/Fiber Expansion Module
EXP-TPS	4-Port Twisted-Pair Expansion Module
EXP-TPS/CXS	2-Port Twisted-Pair/Coax Expansion Module
EXP-TPS/FOG[1]	2-Port Twisted-Pair/Fiber Expansion Module

[1] Specify -ST or -SMA

[2] Specify -485 or -485X

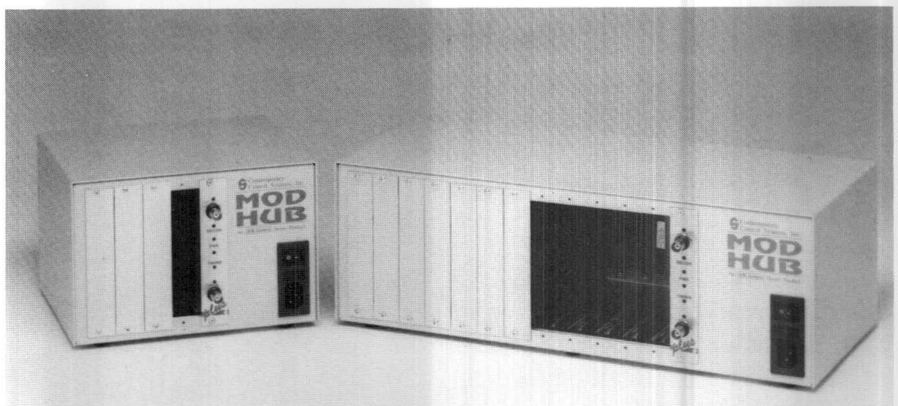
MOD HUB*plus* — For the Toughest of Applications

The MOD HUB*plus* series is recommended for applications that exceed the original intent for cabling ARCNET systems. These applications include extending the distance of twisted-pair links beyond the original ARCNET specification. Another application involves the imposing of conventional baseband ARCNET signals over broadband media.

Like the MOD HUB, the MOD HUB*plus* is available in either 4 slot or 16 slot configurations. However, the MOD HUB*plus* has a specialized timing module that stores incoming signals in a first-in-first-out (FIFO) buffer and retransmits the signals using a precision clock. This reclocking generator is necessary to eliminate the excessive bit jitter experienced when using twisted-pair wiring. Bit jitter will not accumulate through a MOD HUB*plus* active hub. LED indicators on the MOD HUB*plus* function the same as on the MOD HUB. Power levels are monitored and reconfigurations are indicated. The MOD HUB*plus* includes two resident coaxial star (-CXS) ports as part of the timing module. Expansion modules (MXP) are then selected to meet the application.

Expansion modules for the MOD HUB*plus* carry a MXP prefix and are not electrically compatible with the EXP modules. The MXP-4TP requires two slots and provides a long-haul connection (up to 4000') of twisted-pair wiring. The MXP-BB requires a single slot and provides a single ARCNET baseband connection to IEEE 802.7 broadband cabling systems.

The MOD HUB*plus* series addresses the more demanding commercial and industrial applications.



MHP-S and MHP-L can be used with MXP expansion modules to facilitate fast, reliable communication between networked devices.

MOD HUB*plus* Enclosures	
MHP-L	12-Slot Powered Enclosure
MHP-LE	16-Slot Powered Enclosure (240V)
MHP-S	4-Slot Powered Enclosure
MHP-SE	4-Slot Powered Enclosure (240V)
MHP-SF	4-Slot Flanged-Mounted Enclosure
MHP-SEF	4-Slot Flanged-Mounted Enclosure (240V)
MHP-SF-N	4-Slot NEMA 1 Enclosure
MTG-RAK	19" Rack-Mounting Kit

MOD HUB*plus* Expansion Modules	
MXP-4TP	Long-Haul Twisted-Pair Expansion Module
MXP-BBO	Broadband Interface Channels 2'-0
MXP-BBP	Broadband Interface Channels 3'-P
MXP-BBQ	Broadband Interface Channels 4'-Q
MXP-BBR	Broadband Interface Channels 4A'-R
MXP-BBS	Broadband Interface Channels 5'-S

ARCNET Over Telephone Wiring

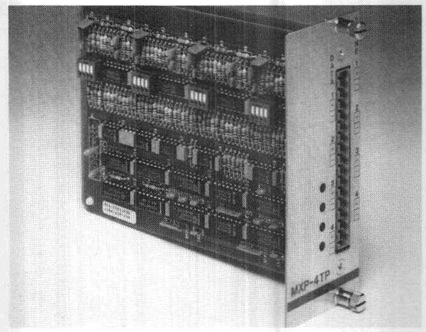
Twisted-pair telephone wire appears to be an ideal media for local area network (LAN) cabling. It is inexpensive, simple to terminate and, most importantly, frequently found in abundance in most commercial, industrial and institutional buildings. There is no need to run additional cabling for a new LAN system if spare telephone pairs could be used.

One of the main problems with twisted-pair telephone wiring is that it was not intended to carry high-speed digital signals. Cable attenuation is significant at higher frequencies, and there is no convenient way to compensate for this problem except to reduce ARCNET's transmission rate of 2.5 Mbps. However, to do this would defeat ARCNET's compatibility with existing equipment. If a general purpose long-haul twisted-pair design is to be implemented, it needs to operate at standard ARCNET speed.

If we could reduce the data rate, we would increase the cable distance. CCSI has developed a novel approach to increasing twisted-pair cabling distances to 4000 feet, with only the cost of increasing the twisted-pair requirements from one pair to four.

The MXP-4TP is a double-wide expansion module (occupies two slots) that is installed into either a MHP-S or MHP-L MOD HUB*plus* Modular Active Hub. The MXP-4TP accepts the backplane signals from the MOD HUB*plus* and generates four "mini-ARCNET" signals, each transmitting at a 625 Kbps rate (1/4 the rate of ARCNET). Each twisted-pair contains information from the original 2.5 Mbps ARCNET signal. The four signals are recombined at the other end of the twisted-pairs by another MXP-4TP which logically "ores" the signals, thereby reconstructing the original ARCNET signal without diminishing the effective throughput of ARCNET.

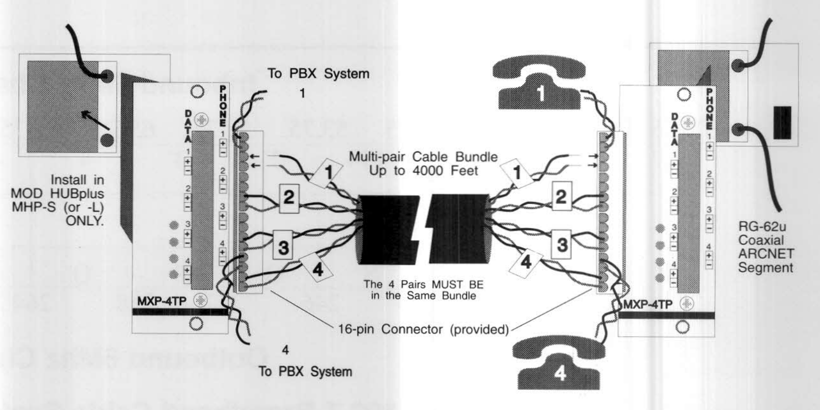
MXP-4TPs must be wired in either a star or distributed star configuration. No bus connections are allowed on the twisted-pair segment. For example, to connect four distant NIMs using twisted-pair cabling in a star configuration use a MHP-S and MXP-4TP near each NIM. Connect the NIM to the MHP-S with coaxial cable. In the center, use a MHP-L and four



The 4TP card makes it possible to connect ARCNET segments from 300 feet up to 4000 feet.

MXP-4TPs. Connect the twisted-pairs between a MXP-4TP near the NIM to one of the MXP-4TPs located in the center. If the remainder of the network uses conventional coaxial cable technology, it is unnecessary to use more MOD HUB*plus* hubs. Simply use conventional MOD HUBs and a coaxial cable connection to a coaxial star port on either the MHP-S or MHP-L.

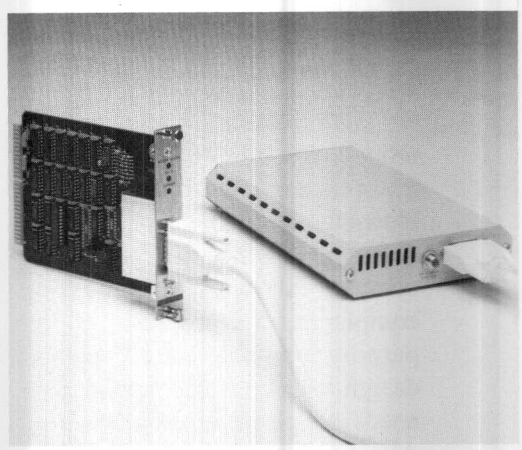
MXP-4TP Cabling Diagram



Broadband communication systems offer the advantage of accommodating multiple voice and data signals over the same coaxial cable. This type of system is frequently found in large manufacturing and process plants, or in large campuses where cabling lengths are significant and vendors are discouraged from installing proprietary cabling systems. Although more complex than baseband systems (one signal over one cable), broadband offers exceptional flexibility in that the cable system remains in place as user equipment is added or deleted from the broadband network. Of course, this flexibility only exists for broadband compatible user equipment, but is not the case with equipment supporting conventional baseband ARCNET communication. For ARCNET equipment to function over a broadband system, a baseband to broadband interface is required. This interface can be implemented using CCSI's MOD HUB*plus* active hub with an installed MXP-BB broadband interface.

The MODHUB*plus* enclosure has built-in two ports of baseband ARCNET BNC connections. A baseband ARCNET node or hub is connected to either one of these ports using RG-62/u coaxial cable. Connection to the broadband network is accomplished using a length of RG-6/u coaxial cable with F connectors at each end. One end attaches to a user tap on the broadband network and the other end to the RF data modem, which is part of the MXP-BB broadband interface.

A broadband communication system in a plant is similar to a cable access television (CATV) system and is actually derived from CATV standards. At the beginning of the cabling system is the headend splitter which creates several spurs, or legs, of cabling to which RF data modems are attached. Attached to the RF data modems is user equipment. The logic-level data stream of "1s" and "0s" from the user equipment to the modems results in corresponding frequency-shifted-keyed (FSK) tones on the cable system. These frequency shift tones occupy a single channel; however, transmit and receive channel frequencies are not the same, thereby facilitating full duplex operation. The receive channel and transmit channel are separated by 192.25 MHz and, together, are called a channel pair. RF data modems transmit at the lower frequency of the channel pair and receive at the higher. To the broadband network, the lower frequencies are called inbound channels and the higher frequencies outbound.



The MXP-BB consists of an expansion module, RF data modem and interconnecting cable.

Inbound 6Mhz Channels

Inbound channel	T11	T12	T13	T14	2'	3'	4'	4A'	5'	6'	FM1	FM2	FM3
Inbound frequencies	29.75–35.75	35.75–41.75	41.75–47.75	47.75–53.75	53.75–59.75	59.75–65.75	65.75–71.75	71.75–77.75	77.75–83.75	83.75–89.75	89.75–95.75	95.75–102	102–108
Outbound channel	K	L	M	N	O	P	Q	R	S	T	U	V	W
Outbound frequencies	222–228	228–234	234–240	240–246	246–252	252–258	258–264	264–270	270–276	276–282	282–288	288–294	294–300

Outbound 6Mhz Channels

IEEE 802.7 Broadband Cable System 192.25 Mhz Offset

ARC DETECT — Low Cost Network Analyzer

CCSI also manufactures devices that assist in analyzing the performance of ARCNET LANs.

The ARC DETECT offers sophisticated ARCNET network analysis in a compact, handheld unit and is a valuable tool in maintaining an ARCNET LAN. The operator can determine which devices are connected to the network, the content of messages being sent, which device caused a reconfiguration and network performance. Using a backlit LCD display, the operator can scroll through the analyzer's data buffer in order to study network traffic.

ARC DETECT is transparent to the network under test since it never joins the network (never participates in the token pass), yet it can examine all other nodes on the network. Since it can examine all nodes, complete traffic on the network can be analyzed including the content of packets. Using a unique filter option, only selected messages can be acquired allowing the operator to key on a particular event of significance. Because ARC DETECT is a real-time device, token rotation time can be displayed and other events can be time stamped as they occur.

Ten Diagnostic Functions

HELP
NET MAP
RECON
TOKEN TIME
LOAD FACTOR
PACKET ASCII
PACKET HEX
PACKET COUNT
PACKET SIZE
SET FILTER

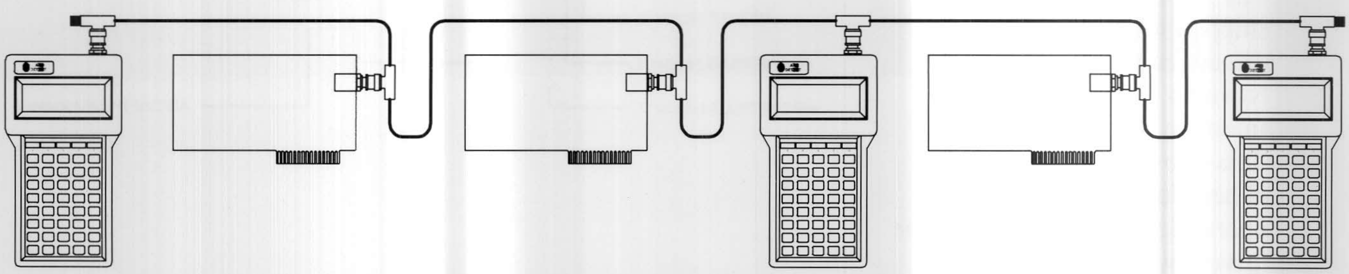
Five Modes of Operation

SNAP SHOT
CONT UPDATE
HEX/DEC
ABS/DELTA
CONFIG/SETUP

The ARC DETECT comes in a carrying case which houses the wall-mounted transformer and accessory items facilitating its use in the field or laboratory.

Analyzing ARCNET networks is simplified with the compact, handheld ARC DETECT network analyzer.

Model	Description
ARCDETECT-CXS	ARCNET Network Analyzer-Coax Star
ARCDETECT-CXB	ARCNET Network Analyzer-Coax Bus
ARCDETECT-PC	ARCNET Network Analyzer Software
ARCDETECT-HOL	Wall-mounted Holster



For hubless systems, connect the ARCDETECT-CXB to either end of the bus segment along with a terminator. No terminator is used for connection within the segment.

ARCPLUS — Boost in Network Performance

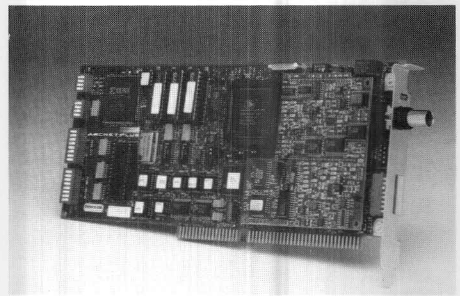
For those applications requiring higher network performance beyond the basic 2.5 Mbps speed of ARCNET, ARCPLUS could be the answer. ARCPLUS incorporates technology developed by Datapoint Corporation. An ISA bus compliant NIM provides dual speed communications up to 20 Mbps while maintaining compatibility with existing ARCNET networks. In addition to the 8X increase in speed, packet sizes of up to 4224 bytes can be sent. Along with improved protocol handling, ARCPLUS can outperform Ethernet by a factor of 2 to 1.

ARCPLUS operates in either one of two modes. Upon power up, ARCPLUS enters an ARCNET emulation mode maintaining compatibility with ARCNET while operating at a 20 Mbps data rate. Software drivers written for ARCNET will function with ARCPLUS in ARCNET emulation mode. However, with enhanced software drivers, ARCPLUS can operate in native mode where the full power of ARCPLUS can be exploited. The ARCPLUS NIM is shipped with native mode drivers compatible with Novell's Open Data-link Interface (ODI) specification. This allows operation with either Novell 3.X or 4.X operating systems. These same drivers will also operate with Microsoft Windows for Workgroups version 3.11.

ARCPLUS only supports star or distributed star topologies.

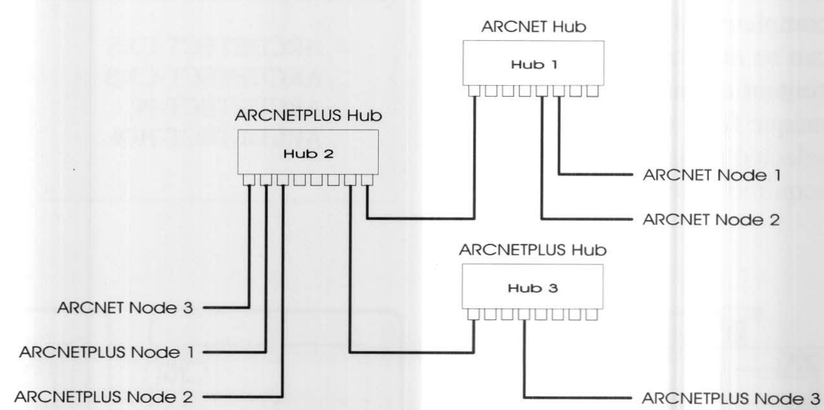
An existing ARCNET LAN and associated active hubs will operate with ARCPLUS if companion ARCPLUS active hubs are purchased and a simple cabling rule is followed. ARCNET nodes or hubs can connect to ARCNET or ARCPLUS hubs, but ARCPLUS nodes can only be connected to ARCPLUS hubs.

ARCPLUS is intended for those applications where high performance ISA workstations need to transfer high resolution graphics and data at high speeds.



The ISA compatible ARCPLUS LAN adapter operates over conventional RG-62/u ARCNET cabling.

Model	Description
ARCPLUS-CXS	ARCPLUS PC LAN Coaxial Star Adapter
ARCPLUS-TPS	ARCPLUS PC LAN Twisted-Pair Adapter



ARCNET nodes or hubs can connect to ARCNET or ARCPLUS hubs, but ARCPLUS nodes can only be connected to ARCPLUS hubs.

REFERENCES

ARCNET Designer's Handbook, Document 61610, Datapoint Corporation, 1983

ARCNET Cabling Guide, Document 51087, Datapoint Corporation, 1988

ARCNET Factory LAN Primer, Contemporary Control Systems, Inc., 1987

RS-485 Cabling Guidelines for the COM 20020, Technical Note 7-5, Standard Microsystems Corporation, January 1992

ADDITIONAL READING

Besides data sheets, application notes and article reprints exist that explain the ARCNET technology in more detail. Request the following material by their number or title:

AN-201	*Baseband ARCNET to Broadband Interface*
AN-202	*Long-Haul Twisted-Pair Interface*
AN-203	*Implementing 20 MB/s ARCNETplus Systems*
AN-204	*Using ARCNETplus With Windows for Workgroups*
AN-205	*Multimaster Communication With Grayhill's MicroDAC*
AN-206	*Using ARCNET With Fiber Optic Cabling*

"ARCNET Simplifies Factory Floor Communications," Control Engineering, October 1987

"ARCNET and NetBios: Low-Cost Communication Combination," Control Engineering, October 1990

"ARCNETplus: Moving Up," Industrial Computing, 1994

Contemporary
Control Systems, Inc.
2512 Wisconsin Avenue
Downers Grove, Illinois 60515 USA
708/963-7070 FAX 708/963-0109

info@ccsi.chi.il.us